EUI WORKING PAPERS IN ECONOMICS

EUI Working Paper ECO No. 91/45

Upstream or Downstream Information Sharing?

SVEND ALBAEK

European University Institute, Florence

Please note
As from January 1990 the EUI Working Paper Series is divided into six sub-series, each sub-series will be numbered individually (e.g. EUI Working Paper **LAW** No. 90/1).

EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

ECONOMICS DEPARTMENT

EUI Working Paper ECO No. 91/45

Upstream or Downstream Information Sharing?

SVEND ALBAEK

BADIA FIESOLANA, SAN DOMENICO (FI)

Printed in Italy in June 1991
European University Institute
Badia Fiesolana
I-50016 San Domenico (FI)
Italy

Upstream or Downstream Information Sharing ?*

Svend Albaek

Department of Economics

European University Institute

June 1991

Abstract:

In a price-setting vertically separated duopoly model I analyse whether the manufacturers will share private demand information themselves, or will leave this to their retailers. In a vertically integrated price-setting duopoly with private demand information, the firms will benefit from committing, before they receive their private demand signals, to pool this information with their rival. Taking this as a starting point, the question asked in this paper is whether the manufacturers, who receive the information through market research, will commit to share this information themselves, or hand it over to their retailers knowing that the retailers subsequently will share the demand signals. The expected profits to the manufacturers from both scenarios are calculated. A comparison shows that the manufacturers always prefer to share themselves.

★ I wish to thank Morten Hviid, Kai-Uwe Kühn, K. Sridhar Moorthy, Louis Phlips and Xavier Vives for helpful comments. Financial support from the Danish Research Academy and the Danish Social Science Research Council is gratefully acknowledged.

1. Introduction.

This paper analyses information sharing in a differentiated Bertrand duopoly which is vertically separated; that is, the two manufacturers sell their products through independent retailers. The demand for the two products is stochastic and not directly observable to the agents. However, in the main part of the paper the manufacturers are assumed to receive private signals about the stochastic demand. The literature on information sharing has shown that in the vertically integrated version of this model the expected profit of each duopolist will increase if the firms (before receiving their signals) commit to sharing their private information with their competitor (Vives 1984, Prop. 4). The objective of the present analysis is to investigate whether the manufacturers will want to share the information themselves or will instead want their retailers to do so.

In the marketing literature the use of retailers and other intermediaries has traditionally been attributed to the intermediaries' having special capabilities for performing their functions. In his widely used textbook Philip Kotler writes: "The use of middlemen largely boils down to their superior efficiency in making goods widely available and accessible to target markets. Marketing intermediaries, through their contacts, experience, specialization, and scale of operation, offer the firm more than it can usually achieve on its own" (Kotler 1988, p. 520). However, recently a number of authors (McGuire and Staelin (1983), Bonanno and Vickers (1988), Lin (1988), Moorthy (1988), Coughlan and Wernerfelt (1989), and Gal-Or (1990)) have shown that there may also be a strategic motivation for manufacturers' choosing to distribute their product through intermediaries. Even when the manufacturers are equally capable of performing the functions of the intermediaries they may choose to delegate tasks to independent agents, e.g. retailers. The fundamental idea behind these papers is that in so doing the manufacturers can ease the competition in the market, since the independent retailer acts as a kind of commitment device. Through the contract between manufacturer and retailer a manufacturer can move the reaction curves of the retailers in a credible way. Using this possibility in a strategic manner can lead to higher profit to the manufacturer than if it undertook the retailing task itself.

The question motivating this paper is then: could the same type of reasoning apply to the manufacturers' private information about a stochastic demand parameter? As referred to above, in a differentiated Bertrand duopoly model there are benefits to each vertically integrated manufacturer from committing to share the information. But the results on vertical separation seem to call for some reflection on whether the information sharing should take place at the manufacturing or at the retailing level if the industry is not vertically integrated. The analysis does, however, lead to perhaps the most intuitive answer, that the manufacturers will prefer to share the information themselves.

The framework for the analysis is a merger of the vertical separation and the information sharing models. The two manufacturers have to choose between an upstream or a downstream information sharing arrangement (UISA or DISA) before they receive the signals about the stochastic demand. Under the UISA the manufacturers share the signals and use the new pooled signal when they contract with their retailers. As in the information sharing literature, information transmission is assumed to be truthful, both between manufacturer and retailer, and between manufacturers (retailers) under the UISA (DISA). Risk-neutral retailers will accept contracts which, conditional on the information about demand, yield nonnegative expected profits. However, assuming that there is a large pool of potential retailers, the expected profits of the two chosen retailers will be zero in equilibrium. The expected profits to the manufacturers from this arrangement are to be compared with those from the DISA. Under the DISA each manufacturer contracts with a retailer on the basis of the manufacturer's private signal (and not the pooled signal, as under UISA). However, the manufacturer takes into account that the retailers will share the information and hence base their pricing decisions on the pooled signal. When one compares the expected profits from the DISA with those from the UISA, the central result of the paper emerges: the manufacturers will prefer the UISA over the DISA except for two pathological cases when they will be indifferent between the two arrangements.

The paper is organized as follows. Section 2 contains the upstream information and Section 3 the downstream information sharing model. In Section 4 the profits to the manufacturers from the two institutional arrangements are compared and the basic result of the paper is presented. In Section 5 the results from a variation of the model are reported: now the retailers get the demand signals and there is a large pool of potential manufacturers. The analytics turn out to be very similar to those of the main model. Consequently the results are also similar: the retailers will always share the information themselves. Finally, Section 6 offers some concluding remarks.

2. Upstream Information Sharing.

The channel structures are fixed and decentralized. That is, each channel consists of a manufacturer and an independent retailer. Each of the two goods is produced exclusively by a manufacturer. A retailer only sells the goods of one manufacturer, as is often (approximately) the case for gasoline stations, car dealers, fast food chains, etc. In order to keep the analysis tractable the market demand is assumed to be characterized by linear demand functions,

$$q_1 = a - bp_1 + dp_2$$
$$q_2 = a + dp_1 - bp_2$$

where q_1 is the demand for product 1 when retail prices are p_1 and p_2. By assumption $a > 0$, $b > d \geq 0$. When $d > 0$ the goods are substitutes; when $d = 0$ they are independent. Notice that I rule out the possibility of goods being complements. The standard assumption of own-elasticities dominating cross-elasticities (b>d) is made. Since the study focuses on demand information, production costs are assumed to be zero. This is equivalent to postulating constant (and equal) marginal costs which are then subsumed into the demand intercepts such that a is interpreted as net of marginal costs.

The strength of demand is assumed to be unknown to both manufacturers and retailers. This is modelled by assuming the intercept a in the demand functions to be a stochastic variable whose prior distribution is common knowledge. Let $a \sim N(\mu,\omega^2)$, where $\mu > 0$ while $\omega^2 > 0$ is finite. Manufacturer i receives an unbiased signal of a denoted s_i.

$$s_i = a + \epsilon_i$$

where $\epsilon_i \sim N(0,\sigma^2)$, σ^2 finite; $\mathrm{cov}(\epsilon_1,\epsilon_2) = \sigma_{12}$, $0 \leq \sigma_{12} \leq \sigma^2$; and $\mathrm{cov}(a,\epsilon_i) = 0$.

In this section the manufacturers are committed to communicate their private information to a trade association, which collects the data and transmits sufficient statistics back to the manufacturers. This is called an upstream information sharing arrangement (UISA). In concordance with the information sharing literature, the analysis concentrates on truthful information transmission. Hence, both manufacturers and retailers always tell the truth, whether it is in their interest to do so or not. While this certainly leaves aside important issues of incentive compatiblity, the assumption may not be as unrealistic as a first glance might suggest. Since knowledge about demand often will be gathered through research activities (perhaps by outside agencies), such information is relatively easy to verify.

The purpose of the information sharing arrangement is to allow better predictions of demand and the rival's price (since in equilibrium the opponent's strategy is known). Given the distributional assumptions above the mean signal $\bar{s} = \frac{1}{2}(s_i + s_j)$ is a sufficient statistic for the posterior mean of a, which is the central estimator in this section. Call this estimator α:

$$(1) \qquad \alpha = E[a|s_i,s_j] = E[a|\bar{s}] = (1-h)\mu + h\bar{s}$$

$$\text{where } h = \frac{2\omega^2}{2\omega^2+\sigma^2+\sigma_{12}}$$

After receiving $\bar{s}$ each manufacturer contracts with a retailer. Manufacturers and retailers are all risk neutral. Hence preference relations are determined entirely in terms of expected profits. I assume that the manufacturers have all bargaining power. This can be justified by postulating the existence of a pool of potential retailers competing for the right to sell the manufacturers' products (see e.g. Bonanno and Vickers (1988)). As a result the two actual retailers will not receive more than their reservation profit levels which are normalized to zero.

The contract between manufacturer and retailer will consist of a wholesale price and a franchise fee, both conditioned on the signal $\bar{s}$. Through the contract the retailers therefore know the value of $\bar{s}$. In the next section the contract will depend on s_i, since there the manufacturers do not share their information. As argued by Coughlan and Wernerfelt (1989), the wholesale price charged to a retailer must be observable to the rival retailer for the strategic effect to work. Hence, by assumption the wholesale prices w_i and w_j become common knowledge after they have been signed. This assumption is, of course, quite heroic, and subject to the criticism of Coughan and Wernerfelt.

The maximization problem of retailer i under upstream information sharing is

$$\max_{p_i} E_a\{(p_i - w_i(\bar{s}))(a - bp_i + dp_j) - f_i(\bar{s}) \mid \bar{s}\}$$

The first order condition gives

$$-2bp_i + bw_i(\bar{s}) + E\{a|\bar{s}\} + dp_j = 0$$

Solving this, and using α for $E\{a|\bar{s}\}$, yields equilibrium retailing prices

$$p_i(\bar{s}) = \frac{\alpha}{2b-d} + \frac{2b^2}{4b^2-d^2}w_i(\bar{s}) + \frac{bd}{4b^2-d^2}w_j(\bar{s}) \tag{2}$$

The corresponding output of firm i is

$$q_i(\bar{s}) = (a-\alpha) + \frac{\alpha b}{2b-d} - \frac{b(2b^2-d^2)}{4b^2-d^2}w_i(\bar{s}) + \frac{b^2d}{4b^2-d^2}w_j(\bar{s}) \tag{3}$$

while the profit of retailer i will be

$$\pi_i(\bar{s}) = [p_i(\bar{s}) - w_i(\bar{s})]q_i(\bar{s}) - f_i(\bar{s})$$

The manufacturer will choose $w_i(\bar{s})$ and $f_i(\bar{s})$ to maximize its profit subject to the constraint that the retailer must earn nonnegative expected profit, conditional on $\bar{s}$. The manufacturer's problem is therefore

$$(4) \qquad \begin{aligned} &\max_{w_i(\bar{s}),f_i(\bar{s})} E_a\{w_i(\bar{s})q_i(\bar{s}) + f_i(\bar{s}) \mid \bar{s}\} \\ &\text{s.t. } E_a\{\pi_i(\bar{s}) \mid \bar{s}\} \geq 0 \end{aligned}$$

As described above, due to the competition from the potential retailers, the constraint in (4) will be binding. This allows a reformulation of the problem (4) to

$$\max_{w_i(\bar{s})} E_a\{p_i(\bar{s})q_i(\bar{s}) \mid \bar{s}\}$$

The first order condition is

$$(5) \qquad E_a\{ \frac{\partial p_i(\bar{s})}{\partial w_i(\bar{s})} q_i(\bar{s}) + p_i(\bar{s}) \frac{\partial q_i(\bar{s})}{\partial w_i(\bar{s})} \mid \bar{s}\} = 0$$

Conditional on $\bar{s}$, the only random element in (5) involves the term $(a-\alpha)$ in (3), which in (5) appears in the form $E_a\{ \frac{\partial p_i(\bar{s})}{\partial w_i(\bar{s})}(a-\alpha) \mid \bar{s}\}$. This is zero since $\alpha = E\{a|\bar{s}\}$. The remainder of (5) is equivalent to the FOC of the manufacturer's problem in a simple deterministic model where the manufacturer chooses w_i to maximize channel profits. The only difference is that the posterior mean of the intercept α is substituted for the actual intercept a. Deriving reaction functions from (5) and calculating the equilibrium values of the wholesale prices is then a simple exercise:

$$(6) \qquad w_i'(\bar{s}) = \frac{\alpha d^2}{b(4b^2-2bd-d^2)} \qquad i = 1,2$$

Inserting (6) in (2) and (3) gives

$$p_i'(\bar{s}) = \frac{2\alpha b}{4b^2-2bd-d^2}$$

$$q_i'(\bar{s}) = (a-\alpha) + \frac{\alpha(2b^2-d^2)}{4b^2-2bd-d^2}$$

Then $f_i'(\bar{s})$ is found as $E_a\{[p_i'(\bar{s})-w_i'(\bar{s})]q_i'(\bar{s}) \mid \bar{s}\}$, since $E_a\{\pi_i(\bar{s}) \mid \bar{s}\} = 0$.

The first lemma sums up the equilibrium contracts.

Lemma 1. *Under the UISA, manufacturer i will, upon receiving the mean signal $\bar{s}$, offer retailers the contract* $[w_i'(\bar{s}), f_i'(\bar{s})]$ *where*

$$w_i'(\bar{s}) = \frac{\alpha d^2}{b(4b^2-2bd-d^2)} \qquad i = 1,2$$

$$f_i'(\bar{s}) = \frac{\alpha^2(2b^2-d^2)^2}{b(4b^2-2bd-d^2)^2} \qquad i = 1,2$$

Notice that, in general, $w_i' = 0$ only if $d = 0$, that is, if the goods are independent. In that case there is no strategic gain to the manufactures from moving the reaction curve at the retailing level. If $d \neq 0$, $w_i' = 0$ only for the probability zero event that $\alpha = 0$.

The resulting expected profit to each manufacturer conditional on the observation of $\bar{s}$ can now easily be found as

$$E_a\{M_i'|\bar{s}\} = E_a\{p_i'(\bar{s})q_i'(\bar{s})|\bar{s}\}$$

(7) $$= \frac{2\alpha^2 b(2b^2-d^2)}{(4b^2-2bd-d^2)^2}$$

The scenario envisaged in this paper is that manufacturers have to decide before receiving their private information whether information will be shared upstream or downstream. For this decision the relevant profit expression is not (7) but rather the unconditional expected profit $E_s\{E_a\{M_i'|\bar{s}\}\}$. This profit expression is the central result of this section and is stated in Lemma 2.

Lemma 2. *The expected profit to each manufacturer from committing to the UISA before receiving private information is*

$$E\{M_i'\} = \frac{2b(2b^2-d^2)(\mu^2+h\omega^2)}{(4b^2-2bd-d^2)^2}$$

Proof: $$E\{M_i'\} = E_{\bar{s}}\{E_a\{M_i'|\bar{s}\}\}$$

$$= \frac{2b(2b^2-d^2)}{(4b^2-2bd-d^2)^2}\, E_{\bar{s}}\{\mu^2 + 2h\mu(\bar{s}-\mu) + h^2(\bar{s}-\mu)\}$$

$$= \frac{2b(2b^2-d^2)}{(4b^2-2bd-d^2)^2}\, [\mu^2 + h^2 \mathrm{Var}(\bar{s})]$$

$$= \frac{2b(2b^2-d^2)(\mu^2+h\omega^2)}{(4b^2-2bd-d^2)^2}$$

since $\mathrm{Var}(\bar{s}) = E\{[\frac{1}{2}(s_i - \mu) + \frac{1}{2}(s_j - \mu)]^2\} = \frac{1}{2}(2\omega^2 + \sigma^2 + \sigma_{12}) = \omega^2/h$.

□

3. Downstream Information Sharing.

In this section the manufacturers do not share their private demand information. Hence the contract between manufacturer and retailer will depend on a private signal s_i, and not the mean signal $\bar{s}$. The retailers learn the signals from the manufacturers through the contract and share this information via a trade association; hence this is a downstream information sharing arrangement (DISA). The manufacturers will take the information sharing among retailers into account when the contracts are signed. It is assumed that the retailers can observe each other's contract schedule so that the knowledge of the rival's signal would also give precise information about the wholesale price the rival is paying its manufacturer.

That the retailers will share the signals is here an assumption. Some justification can be found in Vives (1984) from the result that vertically integrated duopolists engaged in Bertrand competition will share demand information. However, this does not guarantee that it can be shown that the retailers in this model will always share. In fact, it may be hard to formulate a model where this problem can be analysed in a satisfactory way.

Another, and perhaps more appealing, interpretation is that the contracts become public after they are signed, and that this is taken into account by the manufacturers when designing them. When a retailer learns the contract of the rival it can infer what the signal has been, and hence knows the value of both the rival's signal and wholesale price. In a way this interpretation may be closer in spirit to the literature of vertical separation. However, for brevity of exposition I shall stay with the interpretation that retailers actively share information and contract schedules are observable. Note, however, that both interpretations are subject to the criticism of Coughlan and Wernerfelt (1989) referred to in Section 2.

The manufacturers again have all bargaining power; hence the retailers receive zero expected profit conditional on the value of the private signal and the fact that information will be shared among the retailers.

The manufacturers' signals are distributed as described in Section 2. The contracts consist of a wholesale price and a franchise fee conditioned on the signals s_i, i.e. $w_i(s_i)$ and $f_i(s_i)$. After sharing the signals, the retailers' common posterior estimate of a will be α as in (1). The equilibrium at the retailing level will then be determined from the following problem.

$$\max_{p_i} E_\alpha\{(p_i - w_i(s_i))(a - bp_i + dp_j) - f_i(s_i) \mid \bar{s}\}$$

The first order condition gives

$$-2bp_i + bw_i(s_i) + \alpha + dp_j = 0$$

The equilibrium retail prices then become

$$\text{(8)} \qquad p_i(s_i,s_j) = \frac{\alpha}{2b-d} + \frac{2b^2}{4b^2-d^2}w_i(s_i) + \frac{bd}{4b^2-d^2}w_j(s_j)$$

with corresponding outputs

$$\text{(9)} \qquad q_i(s_i,s_j) = (a-\alpha) + \frac{\alpha b}{2b-d} - \frac{b(2b^2-d^2)}{4b^2-d^2}w_i(s_i) + \frac{b^2 d}{4b^2-d^2}w_j(s_j)$$

The resulting profit to retailer i will be

$$\pi_i(s_i,s_j) = [p_i(s_i,s_j) - w_i(s_i)]q_i(s_i,s_j) - f_i(s_i)$$

The manufacturer chooses $w_i(s_i)$ and $f_i(s_i)$ to maximize its expected profit, subject to the constraint that the retailer must earn nonnegative profit conditional on s_i. Since the manufacturer does not know the rival's signal when proposing the contract, the solution concept is Bayesian-Nash. The expectations of a and s_j conditional on s_i are central elements in the manufacturer's decision:

$$E\{a|s_i\} = (1\text{-}g)\mu + gs_i \qquad ; \qquad g = \frac{\omega^2}{\omega^2+\sigma^2}$$

$$E\{s_j|s_i\} = (1\text{-}t)\mu + ts_i \qquad ; \qquad t = \frac{\omega^2+\sigma_{12}}{\omega^2+\sigma^2}$$

The manufacturer's problem is

$$\max_{w_i(s_i),f_i(s_i)} E_{a,s_j}\{w_i(s_i)q_i(s_i,s_j) + f_i(s_i) \mid s_i\}$$

(10)

$$\text{s.t.} \quad E_{a,s_j}\{\pi_i(s_i,s_j) \mid s_i\} \geq 0$$

As in Section 2 the problem can be reformulated since competition among potential retailers makes the constraint in (10) binding:

$$\max_{w_i(s_i)} E_{a,s_j}\{p_i(s_i,s_j)q_i(s_i,s_j) \mid s_i\}$$

The first order condition is

$$E_{a,s_j}\{\frac{2b^2}{4b^2-d^2}[(a-\alpha) + \frac{\alpha b}{2b-d} - \frac{b(2b^2-d^2)}{4b^2-d^2}\, w_i(s_i) + \frac{b^2 d}{4b^2-d^2}\, w_j(s_j)]$$

$$- \frac{b(2b^2-d^2)}{4b^2-d^2}[\frac{\alpha}{2b-d} + \frac{2b^2}{4b^2-d^2}\, w_i(s_i) + \frac{bd}{4b^2-d^2}\, w_j(s_j)] \mid s_i\} = 0$$

Call $\alpha_i = \mathrm{E}_{a,s_j}\{\mathrm{a}|\mathrm{s}_i\} = \mathrm{E}_a\{\mathrm{a}|\mathrm{s}_i\}$. Then

$$\begin{aligned} \mathrm{E}_{a,s_j}\{\alpha|\mathrm{s}_i\} &= (1\text{-h})\mu + \frac{\mathrm{h}}{2}\,\mathrm{s}_i + \frac{\mathrm{h}}{2}\,\mathrm{E}_{a,s_j}\{\mathrm{s}_j|\mathrm{s}_i\} \\ &= (1\text{-h})\mu + \frac{\mathrm{h}}{2}\,\mathrm{s}_i + \frac{\mathrm{h}}{2}\,[(1\text{-t})\mu + \mathrm{ts}_i] \\ &= \alpha_i \end{aligned}$$

since $\mathrm{g} = \frac{\omega^2}{\omega^2+\sigma^2} = \frac{\mathrm{h}(1+\mathrm{t})}{2}$.

The FOC then reduces to

$$(11) \qquad \frac{\mathrm{bd}^2\alpha_i}{(2\mathrm{b}-\mathrm{d})(4\mathrm{b}^2-\mathrm{d}^2)} - \frac{4\mathrm{b}^3(2\mathrm{b}^2-\mathrm{d}^2)}{(4\mathrm{b}^2-\mathrm{d}^2)^2}\,\mathrm{w}_i(\mathrm{s}_i) + \frac{\mathrm{b}^2\mathrm{d}^3}{(4\mathrm{b}^2-\mathrm{d}^2)^2}\,\mathrm{E}_{a,s_j}\{\mathrm{w}_j(\mathrm{s}_j)\mid \mathrm{s}_i\} = 0$$

Equation (11) and its equivalent for firm j can now be solved for $\mathrm{w}_i(\mathrm{s}_i)$ and $\mathrm{w}_j(\mathrm{s}_j)$ which then in turn can be used to find $\mathrm{f}_i(\mathrm{s}_i)$ and $\mathrm{f}_j(\mathrm{s}_j)$:

Lemma 3. *Under the DISA, manufacturer i will, upon receiving the private signal s_i, offer retailers the contract* $[\mathrm{w}_i^+(\mathrm{s}_i), \mathrm{f}_i^+(\mathrm{s}_i)]$ *where*

$$(12) \qquad \mathrm{w}_i^+(\mathrm{s}_i) = \frac{d^2\mu}{b(4b^2-2bd-d^2)} + B_i(s_i - \mu)$$

$$\mathrm{f}_i^+(\mathrm{s}_i) = \frac{(2b^2-d^2)^2\mu^2}{b(4b^2-2bd-d^2)^2} + \frac{b(4b^2+2bd-d^2)^2h\omega^2}{(8b^2-4bd^2-d^3t)^2} - \frac{(8b^3+4b^2d-3bd^2-d^3)(b+d)d^2g\omega^2}{b(8b^3-4bd^2-d^3t)^2}$$

$$\textit{with } B_i = \frac{(2b+d)d^2g}{b(8b^3-4bd^2-d^3t)}$$

Proof: See Appendix.

As in Section 2 interest is focused on the unconditional expected profits of the manufacturers, since the manufacturers have to decide on the type of information sharing arrangement before receiving private information.

Lemma 4. *The expected profit to each manufacturer from committing to the DISA before receiving private information is*

$$E\{\mathbb{M}_i^+\} = \frac{2b(2b^2-d^2)\mu^2}{(4b^2-2bd-d^2)^2} + \frac{b(4b^2+2bd-d^2)^2 h - bd^3(4b+3d)g}{(8b^3\text{-}4bd^2-td^3)^2}\,\omega^2$$

Proof : $\quad \mathrm{E}\{\mathbb{M}_i^+\} = \mathrm{E}\{\mathrm{p}_i^+(\mathrm{s}_i,\mathrm{s}_j)\mathrm{q}_i^+(\mathrm{s}_i,\mathrm{s}_j)\}$

$$= \mathrm{E}\{[\,\frac{2\mu\mathrm{b}}{4\mathrm{b}^2-2\mathrm{bd}-\mathrm{d}^2} + \frac{(4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\frac{h}{2} + \mathrm{d}^2\mathrm{g}}{8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t}}\,(\mathrm{s}_i-\mu)$$

$$+ \frac{(4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\frac{h}{2}}{8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t}}\,(\mathrm{s}_j-\mu)] \;\; \mathrm{x} \;\; [(\mathrm{a}-\alpha) + \frac{(2\mathrm{b}^2-\mathrm{d}^2)\mu}{4\mathrm{b}^2-2\mathrm{bd}-\mathrm{d}^2}$$

$$+ \frac{\mathrm{b}(4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\frac{h}{2} - (\mathrm{b}+\mathrm{d})\mathrm{d}^2\mathrm{g}}{8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t}}\,(\mathrm{s}_i-\mu) + \frac{\mathrm{b}(4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\frac{h}{2}}{8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t}}\,(\mathrm{s}_j-\mu)]\}$$

Using that $\mathrm{E}\{(\mathrm{s}_i-\mu)^2)\} = \omega^2 + \sigma^2$; $\mathrm{E}\{(\mathrm{s}_i-\mu)(\mathrm{s}_j-\mu)\} = \omega^2 + \sigma_{12}$ and $\mathrm{E}\{(\mathrm{a}-\alpha)(\mathrm{s}_i-\mu)\} = 0$, this reduces to

$$\mathrm{E}\{\mathbb{M}_i^+\} = \frac{\mathrm{b}(4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\frac{h^2}{2} - (4\mathrm{b}^2+2\mathrm{bd}-\mathrm{d}^2)\mathrm{d}^3\frac{h\alpha}{2}}{(8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t})^2}\,(2\omega^2 + \sigma^2 + \sigma_{12})$$

$$- \frac{(\mathrm{b}+\mathrm{d})\mathrm{d}^4\mathrm{g}^2}{(8\mathrm{b}^3-4\mathrm{bd}^2-\mathrm{d}^3\mathrm{t})^2}\,(\omega^2 + \sigma^2)$$

Now, $\frac{\mathrm{h}^2}{2}\,(2\omega^2 + \sigma^2 + \sigma_{12}) = \mathrm{h}\omega^2$; $\frac{\mathrm{hg}}{2}\,(2\omega^2 + \sigma^2 + \sigma_{12}) = \mathrm{g}\omega^2$ and $\mathrm{g}^2(\omega^2 + \sigma^2)$

$= g\omega^2$. Then Lemma 4 follows immediately.

□

4. Comparison of Profits.

In Sections 2 and 3 the expected profits to the manufacturers from committing to upstream and downstream information sharing arrangements were calculated. Now these profit expressions are compared to establish the central result of this paper.

Proposition. *The expected profit to each manufacturer from committing to the UISA is never smaller than the expected profit from committing to the DISA. Whenever the demand signals are less than perfectly correlated and the goods are substitutes, the UISA yields strictly greater expected profit.*

Proof: The Proposition is true if and only if

$$(13) \qquad \frac{2b(2b^2-d^2)h\omega^2}{(4b^2-2bd-d^2)^2} \geq \frac{b(4b^2+2bd-d^2)^2h - bd^3(4b+3d)g}{(8b^3-4bd^2-td^3)^2}\,\omega^2$$

Using that $g = \dfrac{h(1+t)}{2}$ both ω^2, h and g can be eliminated. Define f(t) by

$$f(t) = [64b^5d^3 + 16b^4d^4 - 64b^3d^5 - (8t+4)b^2d^6 + 16bd^7 + (4t\text{-}3)d^8]t$$

Then tedious manipulations show that (13) is true if and only if $f(t) \leq f(1)$. From the definition of t, $t \in R_t = [\frac{\omega^2}{\omega^2+\sigma^2}, 1] \subset [0, 1]$. Obviously, if $d = 0$ $f(t) = f(1) = 0$ for all $t \in R_t$. Assume $d > 0$. Then $df/dt > 0$ for all $t \in R_t$. Hence, $f(t) < f(1)$ for all $t \in R_t \setminus \{1\}$, i.e. for all $\sigma_{12} < \sigma^2$.

□

When the goods are independent (d=0) the two arrangements yield the same expected profit to the manufacturer. Since there are then no strategic effects, the only important issue left is the precision of the signal on which the retail pricing decision is made. However, under both arrangements the price is determined on the basis of the pooled signal $\bar{s}$ and is therefore the same. It is equally obvious to see that the two arrangements yield equal profits when the signals are perfectly correlated ($\sigma_{12}=\sigma^2$): information sharing is meaningless since the opponent's signal yields no new information.

The intuition why the manufacturers otherwise want to share the information themselves can best be understood by appealing to the results of Vives (1989, Lemma 3). He shows that when reaction curves are upward sloping the expected profits of a firm increases with the share of its own information that it makes available to its rival. Since expected profits are always increasing in the amount of information available to a firm itself, it follows that a situation where both firms share information must dominate one where they do not share.

The comparison reflected in the Proposition can be interpreted as the result of comparing information sharing (UISA) with not sharing (DISA) in a model with upward sloping demand functions. Reaction functions are upward sloping, as seen from $\partial w_i/\partial E_{a,j} w_j > 0$ in (11), since the manufacturers are interested in easing the retail level competition by responding positively if the rival sets a higher wholesale price. Hence, the Proposition corresponds with the intuition gained from Vives's Lemma 3.

5. Dominant Retailers.

In this section I will describe an extension of the analysis to a market where the retailers, when the terms of the contracts are decided, possess the bargaining power assigned to the manufacturers in the previous sections. Furthermore, the retailers now receive the demand signals. The objective of this variant of the model is to investigate whether it is the position in the chain from manufacturer to consumer which determines where the information will be shared, or whether it is rather the case that the agents who receive the information will want to share it themselves, be they manufacturers or retailers.

From an applied point of view the model in this section is relevant for markets where large retailers dominate the relationship with their producers, e.g. because the manufacturing process can be performed by several potential producers. An example could be large supermarket chains buying products to be sold under the supermarket's name.

As the model is very similar to the one presented in the preceding sections I shall only describe the set-up and results; interested readers can find the details in Chapter 4 in Albaek (1991). Assume that there are two retailers who each contract with one manufacturer chosen from a large pool of potential manufacturers. The competition among these potential manufacturers ensures that the retailers can extract all profits from their chosen manufacturers via a lump sum fee. Hence the two manufacturers in equilibrium receive zero expected profits. The demand functions and the stochastic intercept are as described in Section 2. However, here the retailers receive the signals and have to decide whether to share the information among themselves or pass it on to the manufacturers so that they can share it.

The contracting between retailers and manufacturers is assumed to take place in the following way: the two retailers simultaneously offer contracts [m_1, l_1], [m_2, l_2] where m_i is the margin that retailer i will take over the wholesale price decided by manufacturer i, while l_i is a lump sum fee that manufacturer i will pay retailer i. The retailers can credibly commit to the margins; hence manufacturer i knows that, given m_i, a wholesale price of w_i will lead to a retail price of $p_i = m_i + w_i$. The contracts will depend on the information available to the retailers when the contracts are offered. If the retailers share the information themselves the contracts will depend on the pooled signal $\bar{s}$, while they will be functions of the private signals s_1 and s_2 if the retailers leave the information sharing to the manufacturers.

Somewhat surprising, it turns out that the analytics of this model are almost completely identical to those of Sections 2 and 3. In particular, if the retailers share the information themselves their equilibrium expected profits are identical to those of the manufacturers in Section 2; if the retailers in this section choose not to share information they will receive the same expected profits as the manufacturers in Section 3.

The main result from the extension described here must therefore be equivalent to the proposition in Section 4: When retailers receive the private demand information and competiton among potential retailers drives the expected profits of the manufacturers to zero, the expected profit to each retailer from committing to sharing the information themselves is never smaller than the expected profit from committing to letting the manufacturers share the information. Whenever the demand signals are less than perfectly correlated and the goods are substitutes, sharing the information among themselves yields strictly greater profits to the retailers than leaving the sharing to the manufacturers.

6. Conclusion.

This paper has analysed a particular aspect of information transmission in vertically separated industries. The central result of the paper is clear: in a differentiated Bertrand duopoly model where manufacturers receive private demand information, they get higher profits from upstream than from downstream information sharing. Thus they should share their information themselves, rather than pass it on to their retailers in the knowledge that they will share it. The paper thus predicts that under these circumstances one should expect to find that trade associations acting as information sharing devices proliferate at the manufacturing rather than at the retailing level. The variation in Section 5 clarifies the origin of this result: in the main model it is the fact that the manufacturers receive the information which allows the prediction that the manufacturers will share the information. In the model in Section 5 the retailers receive the signals and the analysis shows that they will then share the information themselves. Thus, if information sharing is beneficial the agents who receive the information will share it. They will not pass it on to other channel members in the hope that the competition conditional on the information will be eased.

The information structure of the model is quite special. It is most adequate for products where manufacturers sell through retailers in a number of (separate) local markets, but where the variations in demand from market to market are quite small. Hence, in the main model the manufacturers support research on the general tendency of demand, while the retailers' knowledge about their local markets is relatively unimportant when contracts are negotiated.

Recently, other authors have taken the opposite approach to the question of vertical restraints with incomplete information. Rey and Tirole (1986) assume that retailers through their local knowledge will possess superior information about the economic environment. However, this knowledge is acquired after the contracts are signed. Hence, the relationship between manufacturer and retailer is analysed as an agency problem where manufacturers choose contracts in a way that maximizes their expected profits under the constraint that the contract must offer retailers nonnegative (ex ante) expected utility (retailers may be risk averse in their analysis). Gal-Or (1988) assumes, in an informational set-up similar to that of Rey and Tirole, that retailers must earn nonnegative profits for every state of nature. In her model, first manufacturers choose either a franchise fee arrangement or a retail price maintenance scheme. In both cases terms of trade will depend on the state of nature. Next the retailer learns the state of nature and communicates this to the manufacturer. In order that the retailer will report the true state of nature, the contracts must satisfy certain incentive compatibility constraints.

The flow of information between manufacturers and their retailers is a fascinating object for study. In general, both parties will possess information which is valuable to the other, and which ought to influence their contract. The manufacturer will possess information about the product itself and estimates of the general state of demand for the product. However, the retailer will have superior knowledge of the local market. At the same time, both manufacturers and retailers may have incentives to communicate their information to their competitors. Much work needs to be done in order to enhance our understanding of the communication between the various agents in such a situation.

Appendix: Proof of Lemma 3.

Basar (1978) has shown that the unique Bayesian equilibrium in this type of model consists of strategies affine in the private signals s_i and s_j (see his Theorem 3). Therefore, assume that manufacturer j's strategy is affine in the signal s_j:

$$w_j(s_j) \;=\; A_j + B_j s_j$$

Then

$$E_{s_j}\{w_j(s_j)|s_i\} \;=\; A_j + B_j E_{s_j}\{s_j|s_i\} \;=\; A_j + B_j(1\text{-}t)\mu + B_j t s_i$$

Substitute this and (1) into (11) to get

(A1)
$$w_i(s_i) = \frac{d^2(2b+d)(1\text{-}g)\mu}{4b^2(2b^2-d^2)} + \frac{d^2(2b+d)g}{4b^2(2b^2-d^2)}\, s_i + \frac{d^3 A_j}{4b(2b^2-d^2)} + \frac{d^3 B_j(1\text{-}t)\mu}{4b(2b^2-d^2)} + \frac{d^3 B_j t}{4b(2b^2-d^2)}\, s_j$$

Since manufacturer i's strategy is also affine, it follows from (A1) that

(A2)
$$A_i \;=\; \frac{d^2(2b+d)(1\text{-}g)\mu + bd^3B_j(1\text{-}t)\mu + bd^3A_j}{4b^2(2b^2-d^2)}$$

(A3)
$$B_i \;=\; \frac{bd^3B_j t}{4b^2(2b^2-d^2)} + \frac{d^2(2b+d)g}{4b^2(2b^2-d^2)}$$

Inserting the symmetrical expression for B_j in (A3) gives the expression for B_i in Lemma 3. Using this in (A2), and the symmetry of A_i and A_j, leads after tedious manipulations to

$$A_i \;=\; \frac{d^2\mu}{b(4b^2-2bd-d^2)} \;-\; B_i\mu$$

This result conforms with the type of decision strategies described by Basar. Inserting (23) in (8) and (9) gives

$$\text{(A4)} \qquad p_i^*(s_i,s_j) = \frac{2\mu b}{4b^2\text{-}2bd\text{-}d^2} + \frac{(4b^2+2bd-d^2)\frac{h}{2} + d^2g}{8b^3-4bd^2-d^3t}(s_i-\mu)$$

$$+ \frac{(4b^2+2bd-d^2)\frac{h}{2}}{8b^3-4bd^2-d^3t}(s_j-\mu)$$

$$\text{(A5)} \qquad q_i^*(s_i,s_j) = (a\text{-}\alpha) + \frac{(2b^2-d^2)\mu}{4b^2-2bd-d^2} +$$

$$\frac{b(4b^2+2bd-d^2)\frac{h}{2} - (b+d)d^2g}{8b^3-4bd^2-d^3t}(s_i-\mu) + \frac{b(4b^2+2bd-d^2)\frac{h}{2}}{8b^3-4bd^2-d^3t}$$

$(s_j-\mu)$

Then (12) is found as $E_{a,s_j}\{[p_i^*(s_i,s_j)-w_i^*(s_i,s_j)]q_i^*(s_i,s_j)\}$ using (11), (A4) and (A5).

□

References.

Albaek, S. (1991), "Essays in the Theory of Duopoly with Incomplete Information", Ph.D. dissertation, Université Catholique de Louvain.

Basar, T. (1978), "Decentralized Multicriteria Optimization of Linear Stochastic Systems", IEEE Transactions on Automatic Control, AC-23, 233-243.

Bonanno, G. and J. Vickers (1988), "Vertical Separation", Journal of Industrial Economics, 36, 257-265.

Coughlan, A.T. and B. Wernerfelt (1989), "On Credible Delegation by Oligopolists: A Discussion of Distribution Channel Management", Management Science, 35, 226-239.

Gal-Or, E. (1988), "Vertical Restraints with Incomplete Information", mimeo, Graduate School of Business, University of Pittsburgh.

-- (1990), "Excessive Retailing at the Bertrand Equilibrium", Canadian Journal of Economics, 23, 294-304.

Kotler, P. (1988), Marketing Management: Analysis, Planning, Implementation, and Control, 6th ed., Englewood Cliffs, New Jersey: Prentice-Hall.

Lin, Y.S. (1988), "Oligopoly and Vertical Integration: Note", American Economic Review, 78, 251-254.

McGuire, T.W. and R. Staelin (1983), "An Industry Equilibrium Analysis of

Downstream Vertical Integration", Marketing Science, 2, 161-191.

Moorthy, K.S. (1988), "Strategic Decentralization in Channels", Marketing Science, 7, 335-355.

Rey, P. and J. Tirole (1986), "The Logic of Vertical Restraints", American Economic Review, 76, 921-939.

Vives, X. (1984), "Duopoly Information Equilibrium: Cournot and Bertrand", Journal of Economic Theory, 34, 71-94.

EUI WORKING PAPERS

EUI Working Papers are published and distributed by the European University Institute, Florence

Copies can be obtained free of charge – depending on the availability of stocks – from:

The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

Please use order form overleaf

Publications of the European University Institute

To The Publications Officer
European University Institute
Badia Fiesolana
I-50016 San Domenico di Fiesole (FI)
Italy

From Name . . . .

Address . . . .

. . . .

. . . .

. . . .

. . . .

❒ Please send me a complete list of EUI Working Papers
❒ Please send me a complete list of EUI book publications
❒ Please send me the EUI brochure Academic Year 1990/91

Please send me the following EUI Working Paper(s):

No, Author . . . .
Title: . . . .
No, Author . . . .
Title: . . . .
No, Author . . . .
Title: . . . .
No, Author . . . .
Title: . . . .

Date . . . .

Signature . . . .

Working Papers of the Department of Economics Published since 1989

89/370
B. BENSAID/ R.J. GARY-BOBO/
S. FEDERBUSCH
The Strategic Aspects of Profit Sharing in the Industry

89/374
Francisco S. TORRES
Small Countries and Exogenous Policy Shocks

89/375
Renzo DAVIDDI
Rouble Convertibility: A Realistic Target

89/377
Elettra AGLIARDI
On the Robustness of Contestability Theory

89/378
Stephen MARTIN
The Welfare Consequences of Transaction Costs in Financial Markets

89/381
Susan SENIOR NELLO
Recent Developments in Relations Between the EC and Eastern Europe

89/382
Jean GABSZEWICZ/ Paolo GARELLA/
Charles NOLLET
Spatial Price Competition With Uninformed Buyers

89/383
Benedetto GUI
Beneficiary and Dominant Roles in Organizations: The Case of Nonprofits

89/384
Agustín MARAVALL/ Daniel PEÑA
Missing Observations, Additive Outliers and Inverse Autocorrelation Function

89/385
Stephen MARTIN
Product Differentiation and Market Performance in Oligopoly

89/386
Dalia MARIN
Is the Export-Led Growth Hypothesis Valid for Industrialized Countries?

89/387
Stephen MARTIN
Modeling Oligopolistic Interaction

89/388
Jean-Claude CHOURAQUI
The Conduct of Monetary Policy: What have we Learned From Recent Experience

89/390
Corrado BENASSI
Imperfect Information and Financial Markets: A General Equilibrium Model

89/394
Serge-Christophe KOLM
Adequacy, Equity and Fundamental Dominance: Unanimous and Comparable Allocations in Rational Social Choice, with Applications to Marriage and Wages

89/395
Daniel HEYMANN/ Axel LEIJONHUFVUD
On the Use of Currency Reform in Inflation Stabilization

89/400
Robert J. GARY-BOBO
On the Existence of Equilibrium Configurations in a Class of Asymmetric Market Entry Games *

89/402
Stephen MARTIN
Direct Foreign Investment in The United States

89/413
Francisco S. TORRES
Portugal, the EMS and 1992: Stabilization and Liberalization

89/416
Joerg MAYER
Reserve Switches and Exchange-Rate Variability: The Presumed Inherent Instability of the Multiple Reserve-Currency System

89/417
José P. ESPERANÇA/ Neil KAY
Foreign Direct Investment and Competition in the Advertising Sector: The Italian Case

* Working Paper out of print

89/418
Luigi BRIGHI/ Mario FORNI
Aggregation Across Agents in Demand Systems

89/420
Corrado BENASSI
A Competitive Model of Credit Intermediation

89/422
Marcus MILLER/ Mark SALMON
When does Coordination pay?

89/423
Marcus MILLER/ Mark SALMON/
Alan SUTHERLAND
Time Consistency, Discounting and the Returns to Cooperation

89/424
Frank CRITCHLEY/ Paul MARRIOTT/
Mark SALMON
On the Differential Geometry of the Wald Test with Nonlinear Restrictions

89/425
Peter J. HAMMOND
On the Impossibility of Perfect Capital Markets

89/426
Peter J. HAMMOND
Perfected Option Markets in Economies with Adverse Selection

89/427
Peter J. HAMMOND
Irreducibility, Resource Relatedness, and Survival with Individual Non-Convexities

* * *

ECO No. 90/1**
Tamer BAŞAR and Mark SALMON
Credibility and the Value of Information Transmission in a Model of Monetary Policy and Inflation

ECO No. 90/2
Horst UNGERER
The EMS – The First Ten Years
Policies – Developments – Evolution

ECO No. 90/3
Peter J. HAMMOND
Interpersonal Comparisons of Utility: Why and how they are and should be made

ECO No. 90/4
Peter J. HAMMOND
A Revelation Principle for (Boundedly) Bayesian Rationalizable Strategies

ECO No. 90/5
Peter J. HAMMOND
Independence of Irrelevant Interpersonal Comparisons

ECO No. 90/6
Hal R. VARIAN
A Solution to the Problem of Externalities and Public Goods when Agents are Well-Informed

ECO No. 90/7
Hal R. VARIAN
Sequential Provision of Public Goods

ECO No. 90/8
T. BRIANZA, L. PHLIPS and J.F. RICHARD
Futures Markets, Speculation and Monopoly Pricing

ECO No. 90/9
Anthony B. ATKINSON/ John MICKLEWRIGHT
Unemployment Compensation and Labour Market Transition: A Critical Review

ECO No. 90/10
Peter J. HAMMOND
The Role of Information in Economics

ECO No. 90/11
Nicos M. CHRISTODOULAKIS
Debt Dynamics in a Small Open Economy

ECO No. 90/12
Stephen C. SMITH
On the Economic Rationale for Codetermination Law

ECO No. 90/13
Elettra AGLIARDI
Learning by Doing and Market Structures

ECO No. 90/14
Peter J. HAMMOND
Intertemporal Objectives

ECO No. 90/15
Andrew EVANS/Stephen MARTIN
Socially Acceptable Distortion of Competition: EC Policy on State Aid

---

** Please note: As from January 1990, the EUI Working Papers Series is divided into six sub-series, each series will be numbered individually (e.g. EUI Working Paper LAW No. 90/1).

* Working Paper out of print

ECO No. 90/16
Stephen MARTIN
Fringe Size and Cartel Stability

ECO No. 90/17
John MICKLEWRIGHT
Why Do Less Than a Quarter of the Unemployed in Britain Receive Unemployment Insurance?

ECO No. 90/18
Mrudula A. PATEL
Optimal Life Cycle Saving With Borrowing Constraints: A Graphical Solution

ECO No. 90/19
Peter J. HAMMOND
Money Metric Measures of Individual and Social Welfare Allowing for Environmental Externalities

ECO No. 90/20
Louis PHLIPS/
Ronald M. HARSTAD
Oligopolistic Manipulation of Spot Markets and the Timing of Futures Market Speculation

ECO No. 90/21
Christian DUSTMANN
Earnings Adjustment of Temporary Migrants

ECO No. 90/22
John MICKLEWRIGHT
The Reform of Unemployment Compensation: Choices for East and West

ECO No. 90/23
Joerg MAYER
U. S. Dollar and Deutschmark as Reserve Assets

ECO No. 90/24
Sheila MARNIE
Labour Market Reform in the USSR: Fact or Fiction?

ECO No. 90/25
Peter JENSEN/
Niels WESTERGÅRD-NIELSEN
Temporary Layoffs and the Duration of Unemployment: An Empirical Analysis

ECO No. 90/26
Stephan L. KALB
Market-Led Approaches to European Monetary Union in the Light of a Legal Restrictions Theory of Money

ECO No. 90/27
Robert J. WALDMANN
Implausible Results or Implausible Data? Anomalies in the Construction of Value Added Data and Implications for Estimates of Price-Cost Markups

ECO No. 90/28
Stephen MARTIN
Periodic Model Changes in Oligopoly

ECO No. 90/29
Nicos CHRISTODOULAKIS/
Martin WEALE
Imperfect Competition in an Open Economy

* * *

ECO No. 91/30
Steve ALPERN/Dennis J. SNOWER
Unemployment Through 'Learning From Experience'

ECO No. 91/31
David M. PRESCOTT/Thanasis STENGOS
Testing for Forecastible Nonlinear Dependence in Weekly Gold Rates of Return

ECO No. 91/32
Peter J. HAMMOND
Harsanyi's Utilitarian Theorem: A Simpler Proof and Some Ethical Connotations

ECO No. 91/33
Anthony B. ATKINSON/
John MICKLEWRIGHT
Economic Transformation in Eastern Europe and the Distribution of Income

ECO No. 91/34
Svend ALBAEK
On Nash and Stackelberg Equilibria when Costs are Private Information

ECO No. 91/35
Stephen MARTIN
Private and Social Incentives to Form R & D Joint Ventures

ECO No. 91/36
Louis PHLIPS
Manipulation of Crude Oil Futures

ECO No. 91/37
Xavier CALSAMIGLIA/Alan KIRMAN
A Unique Informationally Efficient and Decentralized Mechanism With Fair Outcomes

* Working Paper out of print

ECO No. 91/38
George S. ALOGOSKOUFIS/
Thanasis STENGOS
Testing for Nonlinear Dynamics in Historical
Unemployment Series

ECO No. 91/39
Peter J. HAMMOND
The Moral Status of Profits and Other Rewards:
A Perspective From Modern Welfare Economics

ECO No. 91/40
Vincent BROUSSEAU/Alan KIRMAN
The Dynamics of Learning
in Mis-Specified Models

ECO No. 91/41
Robert James WALDMANN
Assessing the Relative Sizes of Industry- and
Nation Specific Shocks to Output

ECO No. 91/42
Thorsten HENS/Alan KIRMAN/Louis PHLIPS
Exchange Rates and Oligopoly

ECO No. 91/43
Peter J. HAMMOND
Consequentialist Decision Theory and
Utilitarian Ethics

ECO No. 91/44
Stephen MARTIN
Endogenous Firm Efficiency in a Cournot
Principal-Agent Model

ECO No. 91/45
Svend ALBAEK
Upstream or Downstream Information Sharing?